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Theoretical Basis of the Design Scheme, Technological Process and Parameters of Base Level Disc Software

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ABSTRACT

In this article, the development of disk softeners for the base leveling and substantiation of their parameters. Analytical expressions describing the process of interaction of the working part with the soil, as well as theoretical analysis of the diameter of the working body, the radius of curvature are described.

KEYWORDS: *Bucket, disk, soil, resource-saving, technology, softening, bullet, area, device, scheme, aggregate speed, machining, diameter, radius of curvature, grinding quality, roughness*

Targeted research is being carried out around the world to develop resource-saving technologies for land leveling and new models of equipment for sowing seeds of agricultural crops, to develop the scientific and technical basis for improving existing machines to ensure resource efficiency.

In the agricultural production of the country, special attention is paid to reducing labor and energy consumption, saving resources, growing agricultural crops on the basis of advanced technologies and the development and application of high-efficiency agricultural machinery.

The Action Strategy for the further development of the Republic of Uzbekistan for 2017-2021 inclu des, in particular, ".further modernization of irrigated lands for modernization and accelerated development of agriculture, development of a network of land reclamation and irrigation facilities, intensive approaches to agricultural production, first of all. Introduction of modern water-saving agro-technologies, wide use of high-yielding agricultural machinery ".One of the important tasks in the implementation of these tasks is to improve the reclamation of irrigated lands and increase the productivity of crops, technical and technological modernization of leveling machines, substantiation of their parameters that ensure high quality and productivity and energy efficiency.

Based on the research, a base leveler equipped with disc softeners was developed. The developed disc softeners consist of the following parts: longitudinal beam 1, right 2 and left 3 axes attached to it at an angle γ and spherical disc softeners 4 mounted on them, the scheme of which is shown in Figure 1.

The spherical discs on the right and left axes are mounted so that they push (turn) the tillage plows in the direction of the longitudinal beam. This ensures that all discs, except the first one on the right axis, work in open cutting conditions, if the blades they process are deformed in the direction of the open edge (zone softened by the previous working body).

As a result, firstly, the traction resistance of the discs is reduced, and secondly, it is possible to increase the transverse distance between the discs by 1.3-1.5 times without compromising the quality of work, which leads to a decrease in energy and material volume of the developed device.

The device is equipped with pressure springs to adjust the depth of immersion of the working bodies in the ground (Fig. 2). In order to ensure that the working bodies replicate the unevenness of the field surface, the device is connected to the frame of the leveler by means of traction, ie hinged.With hydraulic cylinders, the device is moved from the operating position to the transport mode and from the transport position to the operating position. During operation, the working bodies on the right axis of the device push the workpieces to the left and those on the left axis to the right.

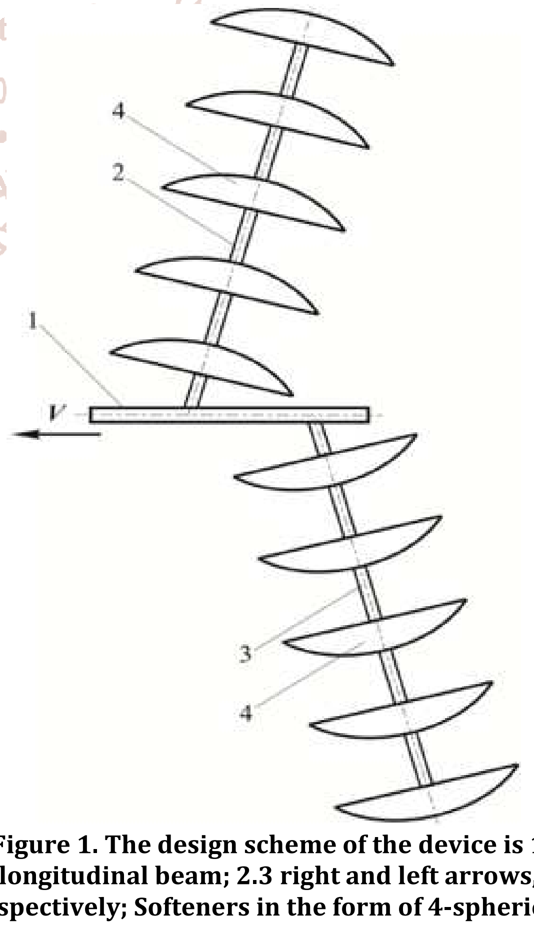

Figure 1. The design scheme of the device is 1 longitudinal beam; 2.3 right and left arrows, respectively; Softeners in the form of 4-spherical

discs.

We study the process of interaction of disk softeners with soil and on this basis produce analytical expressions that allow them to be identified.The base leveler equipped with disc softeners provides a quality leveling of irrigated crop areas, forming a complex of existing tillage machines used in pre-planting tillage.

The working body, located first on the right axis of the device in the direction of movement, operates under closed cutting conditions, i.e. it acts on the solid soil and cuts the ABC slab, which has the appearance of a groove, from it to the field surface (Fig. 2, a).

The surface area C_1 of the cross-section of the slab cut by the working body from the solid soil can be determined by the following expression.

$$S_1 = \left[R^2 \arccos \frac{R-h}{R} - (R-h)\sqrt{R^2 - (R-h)^2} \right] \sin\alpha,$$

(1)

where R = 0,5D - radius of the working body, m;

D - diameter of the working body, m;

h - processing depth, m;

(1) According to the expression, graphs of variation of the surface of the cross-section of the slab cut by the working body in relation to its direction of movement and the depth of machining were constructed (Fig. 3).

It can be seen from these graphs that at all three machining depths, as the mounting angles relative to the direction of movement of the working bodies increase, so does the surface area of the cross-section of the slab cut by them. Because with this increase in angle, the width of coverage in the direction of movement of the working bodies also increases.

All working bodies, except for the first working body in the direction of movement on the right axis of the device, work in open cutting conditions, if they affect the blades with side and softened zone formed by the previous working body, and each working body cuts $A_1B_1C_1$ and $B_1C_1A_2B_2$ leads to the open edge formed by the anterior working body (Fig. 2, b).t

The surface area of the cross section $A_1B_1C_1$ can be determined by the expression C_2 (2.1), and the surface area of the cross section $B_1C_1A_2B_2$ can be determined by the following expression.

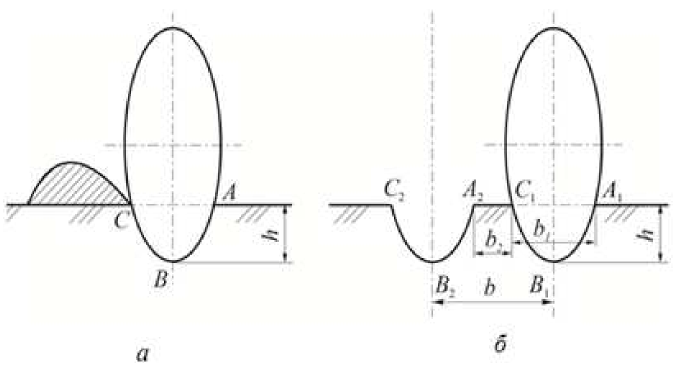

Figure 2 Schemes of interaction of device working bodies with soil

$$S_3 = hb - \left[R^2 \arccos \frac{R-h}{R} - (R-h)\sqrt{R^2 - (R-h)^2} \right] \sin\alpha, \quad (2)$$

where b is the transverse distance between the working bodies, m;

As can be seen from expressions (1) and (2), the size and shape of the earthen plows processed by the working bodies of the device depend on their location, diameter, mounting angle relative to the direction of movement, working depth and transverse distance between them.

During the movement of the device, the working bodies lift, grind and throw the cut soil shovels along the working surfaces due to the movement of the unit forward and rotating around its axes..

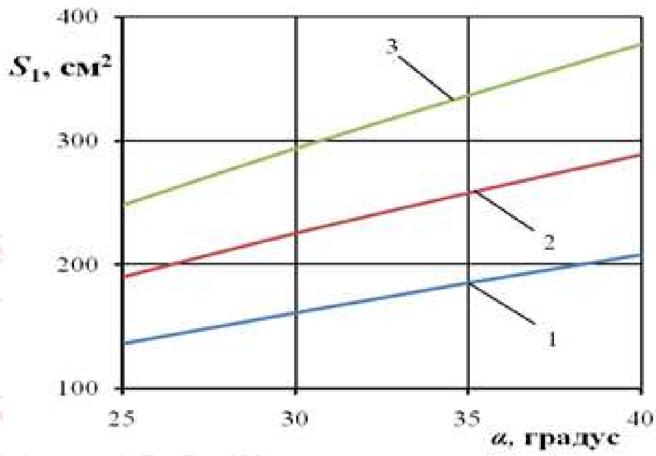

Figure 3. Graph of change of the surface (S_1) of the cross-section of the slab cut by the working body depending on the angle of installation (α) and the depth of processing (*h*) relative to its direction of movement1-h = 8 cm, 2-h = 10 cm, 3-h = 12 cm

We determine the diameter of the workpieces for a given value of machining depth using the scheme shown in Figure 4. From it we get the following

$$D > 2h + d + 2\sqrt{h(D-h)}\, tg\,\gamma, \quad (3)$$

where d is the diameter of the bushing to be installed between the discs, m;

γ – the angle of rise of the soil on the surface of the working body degree.

We give expression (2.3) as follows

$$D^2 - 2D\left[2h\left(1 + tg^2\gamma\right) + d\right] > -\left[(2h+d)^2 + 4h^2 tg^2\gamma\right]. \quad (4)$$

Solving this inequality with respect to D by methods known from the literature, we obtain the following result

$$D > \left[2h\left(1 + tg^2\gamma\right) + d\right] + \sqrt{\left[2h\left(1 + tg^2\gamma\right) + d\right]^2 - \left[(2h+d)^2 + 4h^2 tg^2\gamma\right]}. \quad (5)$$

It can be seen from this expression that the diameter of the working body varies depending on the working depth, the diameter of the bushing installed between the discs and the angle of rise of the working body of the soil along the working surface.

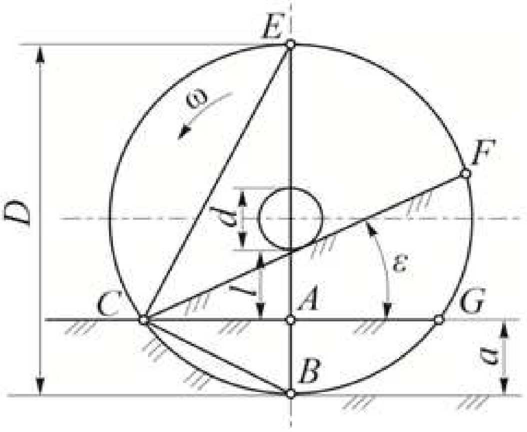

Figure 4. Scheme for determining the diameter of the working body.

The radius of curvature of the working body is determined by the following expression

$$R \geq \frac{D}{2\sin \varphi_э} \qquad (6)$$

Or considering (5)

$$R \geq \frac{1}{2\sin \varphi_э}\left\{\left[2h\left(1+tg^2\gamma\right)+d\right]+\sqrt{\left[2h\left(1+tg^2\gamma\right)+d\right]^2-\left[(2h+d)^2+4h^2tg^2\gamma\right]}\right\}, \qquad (7)$$

Where $\varphi_э$- the arc formed in the equatorial section of the working body central angle, degrees.

Analysis of the obtained mathematical models and analytical connections shows that the agrotechnical (soil compaction quality, heights of surface irregularities during leveling) and energy (drag resistance) performance of a device equipped with a disc softener mounted on a base leveler depends on the diameter of its discs and the curvature of the disc surface. Showed that it depends on other parameters.Based on theoretical research, it can be said that the application of this working body in the current leveling of lands gives good results, increasing productivity due to the improvement of soil composition. This, in turn, will lead to a higher level of agricultural development.

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